Analysis of 2018 Trail Usage Patterns along the Great Allegheny Passage

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Executive Summary

- The Great Allegheny Passage trail system is well used. I estimate the total number of visits to be in the range of 890,620 to 1,009,379 in 2018, with a mid-range estimate of 946,284.

- This represents a decrease in trail use of 7% compared to 2017, which had a mid-range trail use estimate of 1,017,662. The decrease is likely driven by the fact that 2018 was the wettest year on record, dating back to 1871. Pittsburgh experienced 174 days of measurable precipitation in 2018 (15% above normal) and had 57.83 inches of precipitation (51% above normal). Storms and heavy precipitation caused numerous trail blockages throughout the year due to mudslides, rock slides, downed trees, and flooding.

- The TrafX data in 2018 was substantially more comprehensive than in 2017. Specifically, the 2018 TrafX data include a total of 3,211 usable count days compared to 2,381 in 2017, a 35% increase.

- In 2018, volunteers were asked to identify "thru-riders" when conducting manual counts. Based on these counts, I estimate at total of 96,482 thru-riders on the GAP in 2018. However, tremendous variation between locations occurred in the reporting of thru-riders. Because of this, I have little confidence in my estimate of thru-riders. If a count of thru-riders is an important piece of data, I would recommend developing uniform criteria for identifying thru-riders.

Summary of Methodology

This report estimates trail use patterns along the Great Allegheny Passage (GAP), from Cumberland to Pittsburgh. These estimates are based on two primary data sources. The first is information gathered from TrafX counters, infrared counters that track trail use at fixed locations along the trail. The second is information gathered from synchronized manual counts conducted at TrafX counter locations. These synchronized counts occurred on five dates in 2018: Saturday, June 9, Sunday, July 15, Thursday, August 16, Friday, September 14, and Saturday, October 6. In each case, these counts were conducted over a two-hour period (10-noon, 11-1, or noon-2).

I have conducted similar GAP trail use reports in previous years (2010, 2011, 2012, 2013, 2015, 2016, and 2017). The 2010-13 reports also relied heavily on information gathered from TrafX counters and synchronized manual counts, but significant changes in data collection occurred in 2015. To start, three TrafX counters were added, and several existing counters were relocated. In addition, the method for conducting synchronized counts changed substantially in 2015. Previously, synchronized counts were conducted close to trailhead locations, but the synchronized counts were moved to the TrafX counter locations starting in 2015. In addition, synchronized counts are now conducted at fewer locations (12 locations starting in 2015 versus 18 in prior to 2015). **As a result of different data collection methods, trail count numbers for 2015 and later years are not directly comparable to those of previous years.**

I use the following methodology to estimate trail use along the GAP. First, I report raw TrafX counts by location and month for March through December (Table 2). Next, I adjust these raw counts to account for the fact that the TrafX counters typically under-count the actual number of people passing by the counters. I use the 2018 synchronized counts to derive a Count-to-Pass Factor (CP Factor) for each location (Tables 3 and 5). I then apply these CP Factors to derive adjusted TrafX counts (Table 6) and use these adjusted TrafX counts to derive low-, middle-, and high-range estimates of total trail use along the GAP.

TrafX Data

In 2018, TrafX counters collected data at 12 locations along the Great Allegheny Passage. Table 1 provides information on these counters and the data that they gathered.[1]

Table 1: Summary of TrafX Count Data (2018)

Location	Counter milepost	# Usable Count Days	First Date	Last Date
Cumberland	1.5	279	7-Mar	10-Dec
Frostburg	16.5	278	7-Mar	9-Dec
Deal	22.5	278	7-Mar	9-Dec
Garrett	34.5	274	18-Mar	16-Dec
Rockwood	45.5	238	20-Mar	12-Nov
Ohiopyle	69.0	268	26-Mar	18-Dec
Connellsville	85.0	268	26-Mar	18-Dec
Perryopolis	102.0	272	20-Mar	18-Dec
West Newton	111.5	275	20-Mar	19-Dec
Boston	122.0	259	20-Mar	3-Dec
Rankin Bridge	138.0	262	20-Mar	6-Dec
Hot Metal Bridge	146.0	260	20-Mar	4-Dec

[1] The milepost locations of the TrafX counters were provided by David Cotton in an email dated June 2, 2016.

The TrafX data in 2018 was substantially more comprehensive than in 2017. All 12 TrafX counters were operating before the end of March, and all but one (Rockwood) continued to operate into December.[2] Specifically, the 2018 TrafX data include a total of 3,211 usable count days compared to 2,381 in 2017, a 35% increase.

Table 2 displays counts by month (March-December) at the 12 TrafX counter locations, with slight modifications for days in which a counter registers no data or registers a count that is unreasonably high or low. For each counter, I calculate an average weekday and weekend count for each month.[3] On days in which a counter has missing or "bad" data, I insert the average count for that location and month.[4] The March-December range of data represents an expansion from 2017, when I reported counts for April-November. This is a direct result of the fact that the TrafX counters were operational for a longer period of time in 2018. The increased range of data improves the quality of my trail use estimate.

It is worth noting that the raw TrafX counts for Rankin Bridge seem to be extraordinarily high for the months of November (10,946) and December (10,397). In fact, the raw counts for these two months are substantially higher than for any other month at Rankin Bridge, even though one would expect that trail use would low during these months. This fact causes me to believe that the Rankin Bridge counter was not functioning properly during the months of November and December. I account for this malfunction in Table 6, which reports the adjusted TrafX counts.

Finally, it should be noted that the counters are intentionally located away from the trailheads, sometimes as much as 2 miles away. Because of this, many walkers are not included in the count. With these caveats in mind, Table 2 summarizes the raw TrafX counts for each location by month.

Synchronized Counts

Volunteers conducted synchronized counts on 5 dates in 2018: Saturday, June 9, Sunday, July 15, Thursday, August 16, Friday, September 14, and Saturday, October 6. In each case, these counts were conducted over a two-hour period (10-noon, 11-1, or noon-2).

Given 12 locations and 5 synchronized count dates, a full set of data would include 60 synchronized count observations. In fact, only 50 observations occurred. The missing observations are: two at Connellsville (July 15 and October 6), three at Perryopolis (June 9, July 15, and September 14), three at Boston (July 15, August 16, and September 14), and two at Hot Metal Bridge (June 9 and July 15).

Table 3 summarizes the Synchronized Count and TrafX count at each counter for each count day. The last column calculates the overall Count-to-Pass Factor (CP Factor) for each location. The CP Factor equals the manual count divided by the TrafX count.

Note that the CP Factor at Hot Metal Bridge is extraordinarily high (above 26). This means that, on average, for every 26 trail users that pass by, the TrafX counter only recorded 1. The TrafX counter performed particularly poorly on September 14, when it recorded 1 trail user while the volunteer counted 105 trail users. Even on the other two synchronized count dates, the TrafX counter performed poorly, with CP Factors of 11.000 and 29.444. As a result, I am skeptical of the TrafX counts for Hot Metal Bridge for the entire year. I will discuss this further in the adjusted TrafX Count section.

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[2] Beginning on November 13, the Rockwood TrafX counter recorded counts of "0" for every day until it closed on December 17. The Rockwood counts in the days leading up to November 13 were low, but generally not 0. I believe that the counter was not working properly beginning on November 13, so I disregarded these counts.

[3] I define "weekday" as Monday through Friday and "weekend" as Saturday and Sunday. I also count holidays as "weekend" days, even if they occur during the week. In 2018, I counted the following holidays as weekend days: Memorial Day, July 4th, Labor Day, Thanksgiving day, and the day after Thanksgiving.

[4] Specifically, I interpolated counts in this manner for 2 days (August 5-6) when the Perryopolis counter did not report counts.

Table 2: Raw TrafX Counts by Location and Month (2018)

Location	March	April	May	June	July	August	September	October	November	December	Total
Cumberland	1,909	2,949	5,047	4,054	4,680	3,822	3,340	3,990	1,772	1,578	33,142
Frostburg	425	1,384	2,158	2,758	2,534	2,172	2,066	2,167	663	410	16,737
Deal	62	456	1,350	1,831	1,555	1,087	1,060	971	184	113	8,668
Garrett	76	475	1,513	1,939	2,614	1,916	1,769	1,290	108	40	11,740
Rockwood	78	603	1,462	1,799	1,589	1,162	844	473	40	27	8,077
Ohiopyle	610	1,214	3,776	5,782	7,227	5,644	4,137	2,151	345	127	31,013
Connellsville	810	1,217	2,872	3,452	3,283	2,938	2,819	2,101	392	208	20,092
Perryopolis	258	801	1,795	2,342	1,610	2,030	1,770	1,420	347	157	12,529
West Newton	747	2,770	6,379	6,976	7,339	6,044	3,926	2,958	818	707	38,664
Boston	280	996	1,719	1,518	3,063	1,327	1,122	1,867	565	534	12,991
Rankin Bridge	1,894	4,092	5,109	5,558	6,938	4,627	5,261	6,418	10,946	10,397	61,240
Hot Metal Bridge	5,761	7,292	4,795	5,875	7,284	3,506	2,589	3,306	4,421	7,361	52,190
Total	12,910	24,249	37,975	43,884	49,716	36,275	30,703	29,112	20,601	21,658	**307,084**

Table 3: Synchronized Trail Counts (2018)

	9-Jun-18		15-Jul-18		16-Aug-18		14-Sep-18		6-Oct-18		Total		
Location	Manual	TrafX	Manual	TrafX	Manual	TrafX	Manual	TrafX	Manual	TrafX	Manual	TrafX	CP
Cumberland	85	54	36	25	60	49	7	8	40	28	228	164	1.390
Frostburg	45	26	45	22	20	9	8	4	85	35	203	96	2.115
Deal	32	21	38	10	25	9	26	14	66	7	187	61	3.066
Garrett	27	15	38	23	29	14	18	18	48	18	160	88	1.818
Rockwood	24	18	40	15	13	5	18	4	60	14	155	56	2.768
Ohiopyle	192	119	78	53	58	33	42	21	117	30	487	256	1.902
Connellsville	33	26	-----	-----	24	18	19	15	-----	-----	76	59	1.288
Perryopolis	-----	-----	-----	-----	29	11	-----	-----	37	18	66	29	2.276
West Newton	101	35	105	26	70	55	39	28	71	21	386	165	2.339
Boston	158	26	-----	-----	-----	-----	-----	-----	78	39	236	65	3.631
Rankin Bridge	215	56	229	69	32	6	64	20	234	63	774	214	3.617
Hot Metal Bridge	-----	-----	-----	-----	77	7	105	1	265	9	447	17	26.294
Total	**912**	**396**	**609**	**243**	**437**	**216**	**346**	**133**	**1,101**	**282**	**3,405**	**1,270**	**2.681**

CP Factors

By their nature, the TrafX counters do not count trail users perfectly. Specifically, when cyclists ride side-by-side, follow close behind one another, or travel in a group, TrafX counters tend to undercount the number of riders. Thus, the accuracy of a TrafX counter declines when trail use is heavy.

In order to gauge the accuracy of each TrafX counter, volunteers have conducted manual counts at the TrafX counters for many years. These manual counts can be compared to the counts registered by the TrafX counters during the same time period. I use this data to calculate a CP Factor by dividing the manual count by the TrafX count and then use the CP Factors to derive adjusted TrafX counts at each location. Table 4 exhibits this data for 2010-2018.[5]

Table 4: Historic CP Factors (2010-2018)

Year	Manual	TrafX	CP
2010	2,564	1,524	1.682
2011	1,821	1,000	1.821
2012	882	468	1.885
2013	1,123	633	1.774
2014			
2015	2,345	1,324	1.771
2016	5,858	3,107	1.885
2017	3,169	1,593	1.989
2018	3,405	1,270	2.681
Total	**21,167**	**10,919**	1.939

Note that the CP Factor in 2018 is substantially higher than in any previous year. Certainly, the large CP Factor at Hot Metal Bridge contributed to this, but even disregarding the observations at Hot Metal Bridge, the CP Factor in 2018 would be 2.361. This is still substantially higher than in any previous year. It is possible that the accuracy of the TrafX counters was impacted by the historically wet weather that the region experienced in 2018.

Table 5 lists the CP Factors by location for 2018 and, for comparison purposes, for 2017 as well. The data highlight the fact that these factors varied considerably by location to location in 2018 (from 1.288 at Connellsville to 26.294 at Hot Metal Bridge). Note that 8 of the 12 locations had a higher CP Factor in 2018 than 2017, and 4 locations had a CP Factor greater than 3.000, compared to only 1 location in 2017. It is clear that CP Factors were generally higher in 2018 compared to 2017.

[5] No manual counts were conducted in 2014.

Table 5: CP Factors by Location (2018 and 2017)

Location	Manual	TrafX	2018 CP Factor	2017 CP Factor
Cumberland	228	164	1.390	1.614
Frostburg	203	96	2.115	2.891
Deal	187	61	3.066	2.879
Garrett	160	88	1.818	1.402
Rockwood	155	56	2.768	1.561
Ohiopyle	487	256	1.902	1.916
Connellsville	76	59	1.288	3.265
Perryopolis	66	29	2.276	2.018
West Newton	386	165	2.339	2.084
Boston	236	65	3.631	1.723
Rankin Bridge	774	214	3.617	1.519
Hot Metal Bridge	447	17	26.294	2.588
Total	3,405	1,270	2.681	1.989

Adusted TrafX Counts

As mentioned previously, the TrafX counters tend to undercount trail users, particularly when cyclists ride side-by-side or in groups. For this reason, it is appropriate to apply CP Factors to the raw TrafX counts to obtain a more accurate estimate of actual trail use.

Table 6 lists the adjusted TrafX counts by location and month after applying the CP Factors. For the months of March through December, each count listed in Table 6 equals the corresponding count in Table 2 multiplied by the CP Factor for each location. For example, Cumberland's CP Factor is 1.390, and its raw count for March (listed in Table 2) is 1,909. Thus, the adjusted count for Cumberland in March in Table 6 is 2,655 = (1.390) x (1,909). All other counts listed for March through December in Table 6 are calculated in a similar manner.

The counts listed for Rankin Bridge follow this procedure for March through October. However, the counts for Rankin Bridge were unusually high during November and December, leading me to believe that the counter malfunctioned during these months. As a result, I estimate the Rankin Bridge adjusted counts for 2018 as the average of the adjusted counts for the previous three years (2015-2017) for these months.

Furthermore, the CP Factor at Hot Metal Bridge was extraordinarily high. In all three synchronized counts conducted at Hot Metal Bridge, the manual count was far above the TrafX count during the same time period. I examined the daily TrafX counts at Hot Metal Bridge throughout the year, and it did not seem that the TrafX counts recorded on the manual count days were substantially different than the TrafX counts for other days before and after the manual counts. For this reason, I am skeptical of the TrafX counts for Hot Metal Bridge throughout the entire year. So instead of using the raw TrafX counts and CP Factor to calculate the adjusted TrafX count for Hot Metal Bridge, I instead based the adjusted TrafX count for Hot Metal Bridge on the adjusted count for Rankin Bridge, the neighboring TrafX location.

Table 6: Adjusted Monthly TrafX Counts (2018)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Cumberland	73	73	2,655	4,100	7,017	5,636	6,506	5,314	4,643	5,547	2,464	2,194	**46,221**
Frostburg	56	56	899	2,927	4,563	5,832	5,358	4,593	4,369	4,582	1,402	867	**35,505**
Deal	42	42	189	1,398	4,139	5,613	4,767	3,332	3,250	2,977	564	345	**26,658**
Garrett	34	34	138	864	2,751	3,525	4,753	3,484	3,216	2,345	196	73	**21,413**
Rockwood	36	36	216	1,669	4,047	4,979	4,398	3,216	2,336	1,309	111	76	**22,428**
Ohiopyle	94	94	1,161	2,309	7,183	10,999	13,748	10,737	7,870	4,092	656	242	**59,185**
Connellsville	41	41	1,043	1,568	3,700	4,447	4,229	3,785	3,631	2,706	505	268	**25,964**
Perryopolis	45	45	587	1,823	4,085	5,330	3,664	4,620	4,028	3,232	790	356	**28,605**
West Newton	144	144	1,749	6,480	14,923	16,320	17,169	14,139	9,184	6,920	1,914	1,654	**90,739**
Boston	75	75	1,017	3,616	6,241	5,512	11,121	4,818	4,074	6,779	2,051	1,939	**47,318**
Rankin Bridge	242	242	6,849	14,800	18,478	20,102	25,094	16,735	19,028	23,213	5,282	2,360	**152,424**
Hot Metal Bridge	318	318	9,012	19,475	24,315	26,452	33,019	22,021	25,038	30,544	6,950	3,105	**200,567**
Total	1,200	1,200	25,514	61,028	101,441	114,747	133,826	96,793	90,668	94,247	22,885	13,478	**757,027**

Since 2015, 30 hours of synchronized counts have occurred in which volunteers were stationed at both Rankin Bridge and Hot Metal Bridge. In these 30 hours, volunteers have counted a total of 2,333 users at Hot Metal Bridge compared to a total of 1,773 at Rankin Bridge. So in these 30 hours of counts, trail use has been 1.316 times higher at Hot Metal Bridge compared to Rankin Bridge. I use this factor (1.316) to calculate the adjusted TrafX count at Hot Metal Bridge in Table 6. Specifically, I calculate the adjusted TrafX count at Hot Metal Bridge as the Rankin Bridge value times 1.316. For example, in March 2018, the adjusted TrafX count at Rankin Bridge is 6,849. I calculate the adjusted TrafX count at Hot Metal Bridge as 9,012 (= 6,849 x 1.316). I do a similar calculation for each month.

The TrafX counters did not operate during the months of January and February. In previous years, I simply estimated trail use at 100 for each location during these two months, yielding total trail use at all locations of 1,200. This year, I maintained the assumption that total trail use was 1,200 during these two months, but I allocated the trail use according to the patterns observed during the March-December period. For example, during the months of March through December, Cumberland accounted for 6.1% of total trail use. So for January and February, I estimate trail use at Cumberland as 6.1% of 1,200, which is 73. Similarly, West Newton accounts for 12.0% of total trail use during the March-December period, so I estimate its trail use in January and February as 12.0% of 1,200, which is 144. I do a similar calculation for all 12 locations.

Table 6 lists that total adjusted trail use in 2018, per the TrafX counters, was 757,027. This represents a 7% decrease compared to 2017, when total adjusted trail use was at 814,130. ***Thus, my analysis indicates that trail use along the Great Allegheny Passage (GAP) decreased by 7% between 2017 and 2018.***

Interpreting the Adjusted TrafX Counts

The adjusted TrafX counts in Table 6 are derived by multiplying the raw TrafX counts by the CP Factor for each location. As such, the adjusted TrafX counts are a best estimate of the number of times a trail user passes a TrafX counter. Moreover, the adjusted TrafX counts at any location also represents a reasonable estimate of trail usage by those who enter at the trailhead closest to that counter.

Consider, for example, trail use at Ohiopyle. The TrafX counter is located a couple miles down the trail toward Confluence. A rider traveling from Ohiopyle to Confluence and back will pass the counter twice, and the adjusted TrafX count would, on average, double-count this trail user. But other trail users at Ohiopyle will go the opposite direction, toward Connellsville. These trail users will not pass the TrafX counter at Ohiopyle. Some might be counted by the Connellsville counter, but some will not be counted by any TrafX counter. In addition, most walkers who enter at Ohiopyle will not pass a TrafX counter, even if they walk toward Confluence. As a result, we must balance those trail users who will double-counted with those who are not counted at all. It seems reasonable to assume that these two groups are roughly equal. If this is the case, then the adjusted TrafX count provides a good estimate of trail usage at Ohiopyle.

So, given the data available, I view the last column of Table 6 as the best estimate of 2018 trail use at each of the trailheads listed. These estimates will be better for some locations than others depending on how far the TrafX counter is from the trailhead and the proportion of trail users who go in the direction toward the counter. These two factors vary between trailheads, so the estimates in Table 6 likely overestimate trail use at some trailheads and underestimate at others.

Total Trail Use Estimate

The bottom row of Table 6 estimates that trail users passed by the 12 TrafX counter locations a total of 757,027 times. As I have argued above, this number is a reasonable estimate of the number of trail usage by those who enter the trail at the trailheads closest to the TrafX counters. But these 12 locations are not the only places where users may enter the trail. As such, this number likely *underestimates* total trail use.

The locations of the TrafX counters were chosen to capture as many as possible while minimizing the occurrence of trail users passing multiple counters on a single trip. I will assume as a midpoint estimate that 80% of trail visits begin at the trailheads closest to the TrafX counters, with a range of 75% to 85%.[6] Put another way, I estimate that somewhere between 15% and 25% of trail visits begin at a trailhead other than the 12 trailhead locations where TrafX counters are located.

If we assume the midpoint estimate of 80%, then the resulting mid-range estimate of total trail use is 946,284 = (757,027 ÷ 0.80). The low-range and high-range estimates are 890,620 = (757,027 ÷ 0.85) and 1,009,370 = (757,027 ÷ 0.75), respectively. I estimate that trail use along the GAP decreased by 7% between 2017 and 2018.

Thru-Riders

The GAP offers the opportunity for cyclists to take lengthy, multi-day trips. The form that volunteers used when tallying the synchronized manual counts in 2018 provided a section to mark "thru-riders." The volunteer was asked to use his or her judgment to determine whether a passing cyclist was on an extended ride. For example, a cyclist riding with a substantial pack might be a thru-rider.

Table 7 summarizes the number of riders identified by a volunteer as a thru-rider relative to the total number of trail users. The hours in parentheses next to each location indicates the total number of synchronized manual count hours for each location. The last column of Table 7 estimates the total number of Thru-Riders at each location by applying the % of Thru-Riders at that location times the adjusted TrafX count at that location (from Table 6).

Table 7: Thru-Riders in Comparison to All Users (2018)

Location	Thru-Riders	All Riders	% Thru-Riders	Estimated # of Thru-Riders
Cumberland (10 hrs)	40	228	17.5%	8,109
Frostburg (10 hrs)	16	203	7.9%	2,798
Deal (10 hrs)	56	187	29.9%	7,983
Garrett (10 hrs)	13	160	8.1%	1,740
Rockwood (10 hrs)	72	155	46.5%	10,418
Ohiopyle (10 hrs)	47	487	9.7%	5,712
Connellsville (6 hrs)	8	76	10.5%	2,733
Perryopolis (4 hrs)	28	66	42.4%	12,136
West Newton (10 hrs)	58	386	15.0%	13,634
Boston (4 hrs)	34	236	14.4%	6,817
Rankin Bridge (10 hrs)	51	774	6.6%	10,043
Hot Metal Bridge (6 hrs)	32	447	7.2%	14,358
Total	**455**	**3,405**	**13.4%**	**96,482**

[6] These estimates are based on input and estimates by ATA.

The data in Table 7 shows tremendous variation in the percentage of thru-riders, with a range from 6.6% at Rankin Bridge to 46.5% at Rockwood. One would expect some variation between locations arising from differences in the types of trail users at each location. In other words, some locations may attract a higher percentage of casual trail users, while other, more remote locations may naturally have a larger percentage of cyclists on longer journeys. However, some portion of the variation is almost certainly due to the judgment of the volunteers. Consider the difference between Garrett, with 8.1% thru-riders, and Rockwood (just 11 miles away) with 46.5% thru-riders. It is likely that much of the difference these two locations is due to volunteers using different criteria to identify thru-riders.

The bottom-line number from Table 7 is the estimate that there were 96,482 thru-riders on the GAP in 2018. Because of the wide variation between locations in the reporting of thru-riders, I have little confidence in this estimate.

Further Discussion

This report concludes that trail use along the GAP decreased by 7% between 2017 and 2018. This result is likely driven by the fact that 2018 was the wettest year on record, dating back to 1871. Pittsburgh experienced 174 days of measurable precipitation in 2018 (15% above normal) and had 57.83 inches of precipitation (51% above normal).[7] Storms and heavy precipitation caused numerous trail blockages throughout the year due to mudslides, rock slides, downed trees, and flooding.[8]

In addition, the TrafX counters at the two busiest locations on the GAP, Hot Metal Bridge and Rankin Bridge, did not function well at times throughout the year. The manual counts consistently showed the Hot Metal Bridge counter dramatically undercounted. The Rankin counter seemed reliable throughout most of the year but appeared to malfunction in November and December. Given that these two locations historically account for about 40% of the total GAP trail count, the unreliability of their counts create substantial uncertainty regarding the total count for 2018.

Thus, the measured decrease in trail use in 2018 likely reflects poor weather conditions compounded unreliable counts at key locations.

[7] Source: National Weather Service Annual Climate Report for Pittsburgh.
[8] Source: Email correspondence with Bryan Perry on May 31, 2019.